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# PATENT SPECIFICATION

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EXAMINER'S

COPY

Div. 13

472,329

## PROVISIONAL SPECIFICATION

### Improvements in and relating to Rivets and Rivetting

We, A.T.S. COMPANY LIMITED, a Company organised according to the laws of Great Britain, HAMILTON NEIL WYLIE, B.Sc., F.R.Ae.S., British subject, both of 5 3/4, Clements Inn, Strand, London, W.C.2, and GEORGE HERBERT GOULD, British subject, of Whitley Aerodrome, Coventry, Warwickshire, do hereby declare the nature of this invention to be as follows:—

The invention relates to tubular rivets of the kind in which a rivet threaded on a sleeve having an enlarged head is inserted through the plates or the like to be riveted together and has its point expanded or 15 upset by the mandrel head being pulled against it and preferably finally into or through it.

When such rivets are strong to resist shear, they are also strong to resist being 20 upset and expanded and the strength which could be given to such rivets has hitherto been limited by the practicable strength of the mandrels.

Now according to this invention, the rivet is duplex, comprising an outer tubular shell and an inner tubular sleeve and the point, or inner end of the shell is upset or expanded to form a satisfactory head on the inside by the sleeve or part thereof 30 being drawn against it and/or into it.

In one preferred means of carrying the invention into effect, the shell of the rivet is of thin metal and is flanged outwardly at one end to form the outer preformed head 35 of the rivet. The sleeve also has one end outwardly flanged. The external diameter of the main portion of the sleeve is approximately equal to the internal diameter of the shell and the diameter of the flange of the sleeve is not greater than the external diameter of the main portion of the shell. 40 The mandrel is of steel and is provided with a head, being of the type described in British Patent Specification No. 378,617 or with Specification No. 286,471.

In carrying out the process according to the said preferred means, the sleeve is inserted within the shell so that the flanged head of the sleeve is at the end of the rivet remote from the flanged head of the shell. The assembled rivet is threaded upon the mandrel so that the flanged head of the sleeve is adjacent the head of the mandrel

and the stem of the mandrel is inserted in the tool with which the operation is to be carried out. A suitable tool for the purpose is described in British Patent Specification No. 348,818. The head of the mandrel and the stem of the rivet are then thrust into the hole in the work to be riveted so that the flanged head of the shell is pressed against the surface of the work by the anvil of the tool and the tool is operated to apply a thrust to the rivet and a corresponding pull on the mandrel. The head of the mandrel bears against the end of the sleeve which is stiffened against radial expansion by its flange. The pressure causes the shell to compress and bulge and causes the flanged end of the sleeve to be drawn into it. The sleeve thus continues to be drawn in an outward direction inside the shell expanding the latter until such expansion reaches the inner surface of the work that is being riveted. 55 60 65 70 75 80

In the above described means of carrying the invention into effect, the shell is preferably of light metal alloy and the sleeve of stainless steel, but the invention 85 is not limited to the use of such metals and both shell and sleeve may be of similar metal if desired.

The length of the sleeve may be such that at the end of the operation its plain end has been drawn through the shell so that it is flush with the flanged end of the shell, but in a preferred form it is of greater length and is drawn through so that it projects beyond the shell flange. The projecting portion may be subsequently spun over so that it overlies the shell flange. 90 95

In the assembly of the rivet, it is not essential that the sleeve be of a size to fit within the shell. It may be of such a diameter that it will not enter the shell until forced in by the mandrel, but it is advisable that it should initially be entered at least within the point of the shell. Moreover the riveting operation 100 105

may be complete without the flange of the sleeve having been drawn into the shell.

In an alternative form the sleeve has no flange but tapers in outside diameter, the bore being uniform. In this case the wider end of the sleeve is placed adjacent the head of the mandrel.

In carrying out the process the mandrel may be of the type described in which the head is reduced in diameter during its passage through the rivet or alternatively

it may be of a type in which the head is not so reduced. In such case the mandrel is of material much harder than the sleeve and the diameter of the head of the mandrel is only slightly more than the bore of the sleeve. Alternatively the head may be simply pulled against the sleeve.

Dated this 26th day of March, 1936.

S. SANDERS,  
Acting for the Applicants.

## COMPLETE SPECIFICATION

### Improvements in and relating to Rivets and Rivetting

We, A.T.S. COMPANY LIMITED, a Company organised according to the laws of Great Britain, HAMILTON NEIL WYLIE, B.Sc., F.R.Ae.S., British subject, both of 3/4, Clements Inn, Strand, London, W.C.2., and GEORGE HERBERT GOULD, British subject, of Whitley Aerodrome, Coventry, Warwickshire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The invention relates to tubular rivets of the kind in which a rivet threaded on a mandrel having an enlarged head is inserted through the plates or the like to be riveted together and has its point expanded or upset by the mandrel head being pulled against it and preferably finally into or through it.

When such rivets are strong to resist shear, they are also strong to resist being upset and expanded and the strength which could be given to such rivets has hitherto been limited by the practicable strength of the mandrels.

Now according to this invention the rivet is duplex comprising an outer tubular shell and an inner tubular sleeve, one end of the outer shell has a preformed flange and the other end is upset or/and expanded after insertion in the structure by the sleeve being moved longitudinally relatively to the shell and drawn against or/and into it, by a headed pin or mandrel acting through the bore of the rivet.

The relative diameters of the sleeve and shell may be such that the sleeve is inside the shell before the rivet is inserted in the structure or may be such that the sleeve expands the shell when drawn into it after the rivet is inserted in the structure. The sleeve may have a flange which bears on the point or inner end of the shell and prevents the sleeve from being drawn too far into the shell and the strength of this flange may be made such that it is drawn

into the point of the rivet before the mandrel head pulls through it or breaks off.

One preferred means of carrying the invention into effect is illustrated in Fig. 1 of the accompanying drawings in which *a* is the tubular shell having a flange *b* at its outer end, i.e., the end on the outside of the structure, and *c* is the tubular sleeve which in this case has a flange *d* on its inner end which bears on the inner end *a* while the stem of *c* fits closely inside the bore of *a*. The mandrel *e* which is threaded through *a* and *c* has a tapered head which bears on *d*. The assemblage comprising *a*, *c*, and *e* is inserted through the plates *f* and *g* which are to be connected and pressure is applied to flange *b* to hold it firmly against *g* while *e* is strongly pulled as by the tool described in British Patent Specification 348,818. The pull on *e* first causes *d* to press so heavily on *a* that *a* compresses and swells out as shown in Fig. 2 thus forming an inside head *h* and then, as the pull on *e* is increased it draws the head of *e* through *c* expanding it tightly into *a*, and *a* tightly into the holes. Further pulling of *e* reduces the head by a wire drawing action when passing through the portion of *c* supported by the plates *f* and *g*. *c* is finally drawn clear as shown in Fig. 3 and as described in British Patent Specification No. 286,471.

In the above construction the shell *a* may be of comparatively soft material such as Aluminium Alloy preferably having an ultimate tensile strength of about 15 tons per square inch, and the sleeve *c* of a harder material such as Mild Steel or of an alloy of similar strength and in such case the mandrel is preferably of relatively hard steel in order to possess the necessary strength to enable it to expand the rivet. The shell and sleeve may also be of similar material the flange of the sleeve in this case being made sufficiently thick to possess the necessary strength.

An alternative preferred method of

carrying the invention into effect is illustrated in Figs. 4 and 5 in which parts corresponding to parts in the previous figures are designated by the same letters.

5 In this construction sleeve *c* rests on the end of the shell *a* and is drawn against it crushing and expanding it after the assemblage has been inserted in the plates *f* and *g* and is ultimately drawn into it thus  
10 further expanding it. The mandrel may have a cheese shaped head as described in British Patent Specification No. 378,617. Since the inside of the head is flat or only slightly conical it is capable of exerting  
15 greater pressure on *d*. This pressure pulls flange *d* into the end of *a* as shown in Fig. 5 until it encounters the resistance of *f* which it pulls hard against *g* by shortening the stem of *a* before the pull is sufficient  
20 to withdraw the head of *e* right through *d* and *c* thus expanding *d* tightly into *c* and expanding *c* and *a* tightly in the holes in *f* and *g* as *e* finally comes clear of the rivets. This mandrel is preferably of very  
25 strong steel and since it effects its purpose without requiring to deform it may be of such hard steel that it is uninjured and so can be used repeatedly.

In a slightly modified construction the  
30 mandrel has a relatively large head and may be notched or reduced in section as shown in Fig. 6 so that it breaks off and remains in the rivet.

In Fig. 4 the shell and sleeve are shown  
35 of tapering thickness the thickness being greatest near to the flange and thinnest at the point. This variation in thickness is convenient for production reasons in rivets which are pressed from sheet. In  
40 the duplex rivet the thin part of the sleeve complements the thick part of the shell

and vice versa so that the shear strength of the complete rivet is substantially constant throughout its length. The sleeve may be short so that it reinforces only the  
45 outer end of the shell. The sleeve may have a very small flange or may be without a flange.

Having now particularly described and ascertained the nature of our said invention  
50 and in what manner the same is to be performed, we declare that what we claim is:—

1. A duplex rivet comprising an outer tubular shell and an inner tubular sleeve  
55 one end of the outer shell having a pre-formed flange and the other end being upset or/and expanded after insertion in the structure by the sleeve being moved longitudinally relatively to the shell and  
60 drawn against or/and into it, by a headed pin or mandrel acting through the bore of the rivet.

2. A rivet as claimed in Claim 1 in which the relative diameters of sleeve and  
65 shell are such that the sleeve expands the shell when drawn into it after the rivet is inserted in the structure.

3. A rivet as claimed in Claim 1 in which the sleeve has a flange which bears  
70 on the end of the shell.

4. A rivet as claimed in Claim 3 in which the sleeve flange is forced inside the expanded end of the shell.

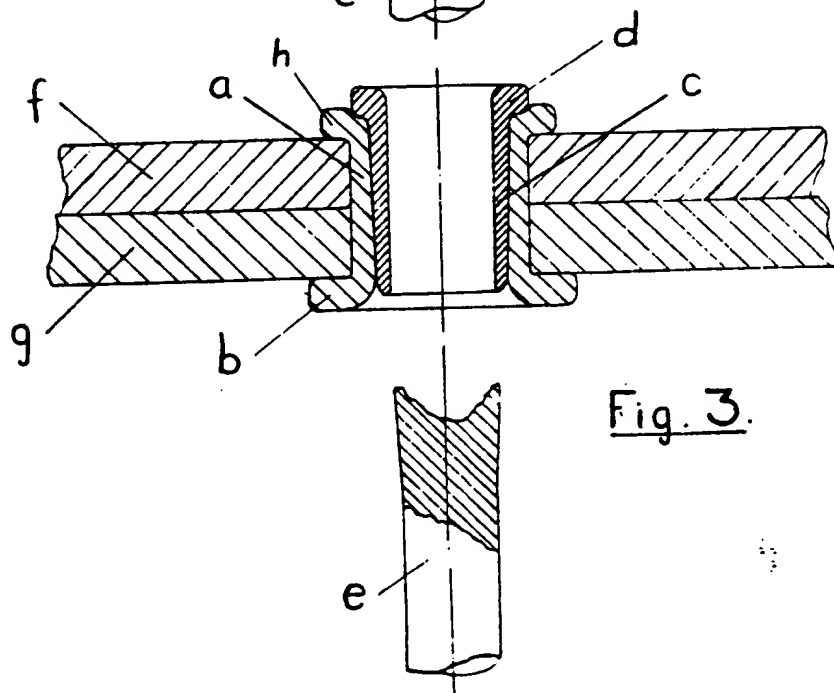
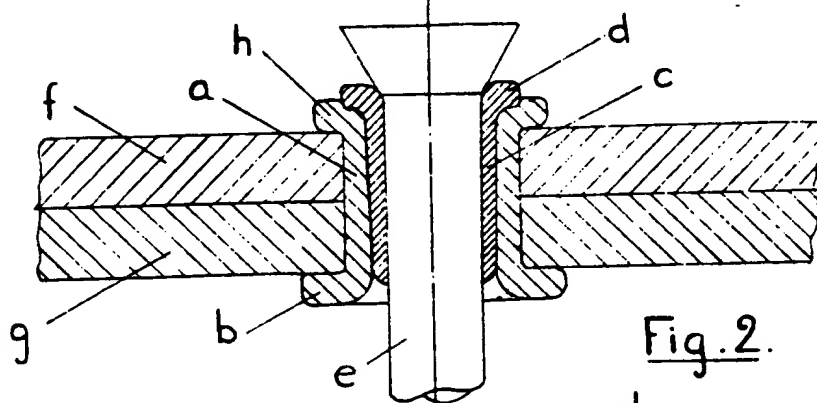
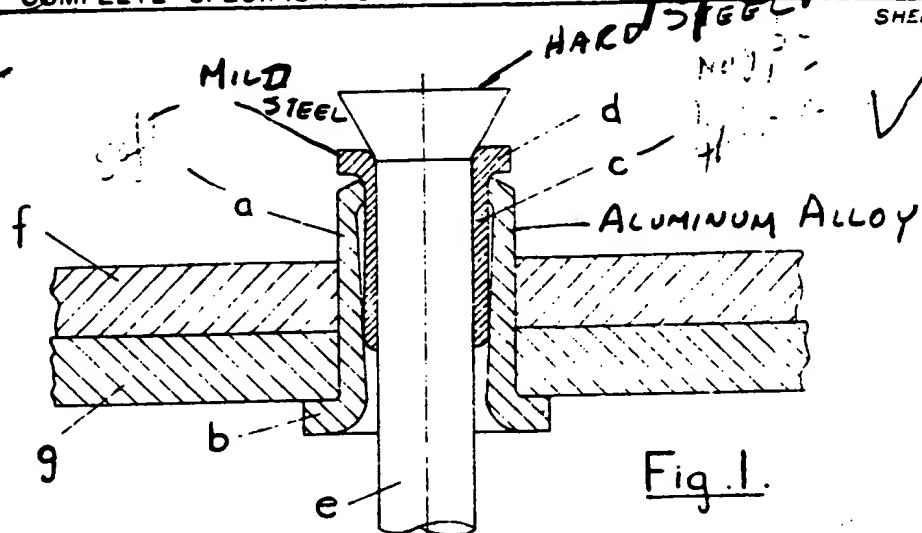
5. A rivet as claimed in Claim 1 in  
75 which both shell and sleeve are expanded by the mandrel head being drawn through them.

April 24th, 1937.

For Self and Co-Applicants,  
H. N. WYLIE.

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472,329 COMPLETE SPECIFICATION

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